2016

2016 Newsletter

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Fall 2016 Vol 18 No I

FROM THE DIRECTOR

Funding Odds Mort Sternheim

Our most recent Advancing Informal Science Education (AISL) proposal was not was not among the 9% that were funded by the National Science Foundation. We asked our program officer about the success rates for education proposals. This is what he replied:

> *ITEST [Innovative Technology Experiences for Students and Teachers] will probably have a success rate of 12 to 15 %; DR K-12 [Discovery Research PreK-12] around 7 or 8%.*
>
> *It depends on the program; there are about 30 in EHR [Education and Human Resources]. But all you have to do is to look at the funding over the years and the number of proposals received. ITEST funding fluctuates due to the H1-B visa funding source, but the number of proposals has been increasing. DR K-12 funding has decreased over the last three years, while the number of proposals has increased 5 to 10% per year. Same with AISL.*

That message was not nearly as depressing as a later one from the National Ocean and Atmospheric Administration announcing

> *$2.5 million in Environmental Literacy Grants to support five projects focused on helping communities build environmental literacy… We received 170 applications from 40 states, the District of Columbia, and 3 U.S. Territories, with a total request of more than $77 million.*

That works out to less than 3% of the proposals receiving funding. It's better that the Massachusetts lottery, but still awfully discouraging. It is also much better than NOAA's 2011 record. ***They received 350 three page letters of intent and invited 45 full proposals, including one from STEM Ed.*** Shortly after announcing seven awards (not to STEM Ed), they sent out this remarkable email:

> *This has been a very uncertain year with regard to NOAA's budget, and unfortunately, due to substantial cuts,* ***we do not have sufficient funds available to fund any of the applications*** *that were submitted to the 2011 Environmental Literacy Grants.*

It would be interesting to know the total cost of creating all these unsuccessful proposals. Each involved numerous meetings of potential participants, lots of emails, drafts and redrafts of proposal narratives, budgets, etc., requiring hundreds hours of work. Maybe we could get a grant to study this question.

Table of Contents:

Tuesday Talks

Most STEM seminars are held at 4PM on the first and third Tuesdays of each month during the academic year in Hasbrouck 138. Everyone is welcome; no reservations are needed, and there is no charge. Refreshments are served starting at 3:50. Parking is available in the Campus Center Garage.

PVSTEMNet Update

After more than a decade, the Pioneer Valley STEM Network no longer exists in its previous form. The nine regional networks in fiscal 2016 went without funding while the new administration pondered what the networks should look like. In April, a Request for Proposals was issued calling for five networks and announcing new priorities. Holyoke Community College submitted a PVSTEMNet proposal which was not funded. The Massachusetts College of Liberal Arts Berkshire proposal was accepted and they were also asked to serve the Pioneer Valley. Details of this arrangement are not yet defined.

August 2 press release **Baker-Polito Administration Awards $260,000 TO PROMOTE STEM EDUCATION**

BOSTON – The Baker-Polito Administration today announced over $250,000 in grant awards to support the Commonwealth's Regional STEM (Science, Technology, Engineering, and Mathematics) Networks. Begun in 2004, the state's Regional STEM Networks, often hosted by institutions of higher education, serve as hubs for connecting educators, community leaders and industry partners to further excite and energize students about opportunities in STEM subjects. These networks are among the longest standing STEM Networks in the country.

"I thank all of our STEM Network partners who are working to help meet the future needs of our rapidly changing economy and bolster skills in science, technology, engineering, and mathematics," said Governor Charlie Baker. "Our collective efforts continue to increase engagement in and raise awareness about the importance of STEM education both for our economy and the new opportunities it creates for our young people."

"Capturing students' interest in learning about and working in STEM careers is critical for our economy," said Lt. Governor Karyn Polito, a co-chair of the STEM Advisory Council. "These Regional STEM Networks serve as the local centers for building excitement and energy for students about potential futures in STEM careers."

"We must connect local industry and community organizations with schools to ensure that students are able to see the exciting opportunities in STEM fields in their region," said Secretary of Education Jim Peyser. "The Regional STEM Networks play an invaluable role in promoting and expanding STEM opportunities for students in collaboration with employer partners and local colleges and universities."

The fiscal year (FY) 2017 grant for the Regional STEM Networks included incentives for collaboration across regions as well as for aligning focus areas with STEM Advisory Council priorities.

Those priorities include:

- **Expanding work-based learning opportunities for high school students, particularly in STEM fields;**
- **Developing and implementing models of STEM Early College Career Pathways; and**
- **Broadening access to computer science and engineering courses.**

The fiscal year (FY) 2017 funding from the Commonwealth's STEM Pipeline Fund will support Regional STEM Networks across the state, including collaborations between state colleges, WPI, and various community and industry partners.

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The Arsenic Education Projects

Julian Tyson

Professor Emeritus, Department of Chemistry

University of Massachusetts Amherst

Tyson's arsenic research has impacted education at all levels: doctoral research, undergraduate and K12 classrooms, and the general public.

The potential health hazards associated with the presence of arsenic compounds in food and drink are never far from the headlines. Although some arsenic compounds are harmless, many of those that we ingest are not; indeed, the most widespread compounds are human carcinogens and others cause cancer in some lab animals.

Arsenic is the 50th most abundant element in the earth's crust at concentrations in rocks and soils of a few parts per million, and of a few parts per billion (ppb) in the oceans. The mineral compounds are not completely inert: we have been able to extract arsenic and make a wide range of compounds that we distribute for various purposes. Most, but not all, arsenic compounds are toxic. So are all chemicals—it all depends on how you interact with them--but, with some arsenic compounds, toxic effects appear with very low concentrations and amounts ingested. The legal limit for arsenic in drinking water in the US is 10 ppb; in other parts of the world it is 50 ppb.

Arsenic compounds have been, and still are, used as pesticides, herbicides and fungicides. We spray solutions of them on roadsides, orchards, lawns, and we impregnated timber for construction purposes with a solution of chromium, copper and arsenic. This kind of wood is no longer available for domestic use, but that there is still a considerable legacy demands attention. It is not known to what extent this material is responsible for environmental contamination. We have also inherited many sites formerly used for chemical manufacturing, as arsenic compounds were often discarded along with other wastes. "Arsenic" ranks first on the list of contaminants posing the most significant potential threat to human health, raising the enormous issue of how to remediate such sites.

Naturally occurring arsenic compounds (mostly inorganic arsenite and arsenate) can get into drinking water. While the arsenic contamination of ground water (from rocks) is a serious problem in the US (quite locally), it is a major problem in Bangladesh and West Bengal, India, where millions of people are drinking highly contaminated water and are showing signs of arsenic poisoning. The relevant issues are (a) how can we remove arsenic from contaminated water and (b) how can we test—in poor communities—that the water is safe? We now see arsenic contamination in food, especially rice, due to irrigation with contaminated groundwater or to a residue of previous applications of arsenic-containing pesticides and herbicides. Some US rice is contaminated probably from the chemicals used to support cotton production. The concentrations are high enough to exceed acceptable risk thresholds, and there are calls for the US FDA to introduce regulations, which we are now starting to see.

There are other issues: arsenic-containing drugs are fed to chickens, arsenic was a component of some embalming fluids and may now be leaching out of cemeteries, and arsenic may be a contaminant of deicing salts. Arsenic compounds (especially lead arsenate) were used as pesticides in the production of fruit (including in local orchards), and are currently still used as herbicides on golf courses. Concerns are being expressed over the residues of arsenic compounds that were used as chemical warfare agents. These same agents could, possibly, be used in a terrorist attack.

Educational Impact

This background is a rich source of material for engaging students in a variety of learning activities both on and off the campus. I have developed two broad pedagogical themes based on the chemistry, (environmental, analytical, biological) and other related sciences (toxicology, epidemiology, statistics, public health) needed to understand our interactions with arsenic compounds and the possible consequences. In theme one, students join my research group and work on a project of current interest; in theme two, arsenic-related topics are woven into the fabric of formal classes. In addition, since the fall of 2014, I have been helping Chemists Without Borders [ref 1] implement a vision of engaging students as agents of change in several arsenic projects in Bangladesh.

Although graduate students in my group had been working on developing chemical measurement methods in support of a variety of arsenic-in-the-environment projects as far back as 1990, it wasn't until 2002, when STEM Ed received a grant from the NSF's Graduate Student in K-12 Education (GK-12) program, that I became aware of the low-cost, field test kits for arsenic. In this program graduate students spent several hours a week in middle-school classrooms working with the teachers to implement inquiry–based learning activities around the research interests and scientific expertise of a number of faculty members. Since then these kits

have supported the work of a number of K-12 teachers in several programs offered by STEM Ed and funded by NSF. The first of these was Research Academies for Young Scientists, known on the UMass Amherst campus and Holyoke Community College as STEMRAYS [ref 2], in which teachers ran after-school science clubs on environmental issues. Arsenic topics formed the basis for activities by seven teachers, each of whom led a club of about 10 students (grades 4 – 6). The following year, two teachers were trained to be club leaders. There was an education research component to the project, and the results formed the basis of a publication in the science education literature [ref 3]. The next was an Innovative Technology Experiences for Students and Teachers (ITEST) program [ref 4]. The UMass Amherst program was known as STEM DIGITAL (digital images in geoscience investigations: teaching analysis with light), and once again featured several environmentally related themes for which chemical measurement was needed. This time, all the measurements were of the interaction of ultraviolet, visible or infrared light with relevant materials captured in digital images that were subsequently analyzed by suitable software. For three summers, 30 teacher participants learned about the problems of arsenic contamination of groundwater and of rice and of the role of spectrochemical analysis (as exemplified, at least for the arsenic-related projects, by the Gutzeit-Marsh reaction augmented by digital image analysis) in supporting such investigations. The teacher participants took materials back with them to further develop curricular materials for their students.

More recently, I have been working with Andrew Patari at Four Rivers Charter School in Greenfield, whose 11th grade chemistry students have been working on semester-long projects related to the performance of the kit test. We've just completed the third round of projects.

Undergraduate Independent Study

In fall 2004, I created a course-based undergraduate research experience for undergraduate students at UMass Amherst taking the first- or second-semester of the general chemistry sequence. This program has now run for 20 semesters and over 540 students have participated. Students work in small groups, sometimes with a more experienced undergraduate, on a project related to my interests in the environmental and analytical chemistry of arsenic compounds. They write (a) a background paper that includes a description of one measurement technique, and some suggestions for the initial experiment (not exactly a research proposal, but the analogue of one), and (b) a final report in the form of a journal article.

This introduction to the relevant issues has been an effective way of recruiting undergraduate students into my research group and since the fall of 2004, about 65 students have worked on independent studies,

many of which lasted for multiple semesters. In addition, NSF supplements to research grants and an Alliance for Graduate Education and the Professoriate, a major NSF initiative aimed at increasing participation in STEM graduate programs by under represented minorities (known as the NE Alliance) funded about 16 participants in summer REUs (research experiences for undergraduates) in my group, almost all of whom worked on arsenic-related topics.

Arsenic Topics in Chemistry Courses:

Junior-Year Writing in Chemistry

The University of Massachusetts Amherst has a writing requirement consisting of two, three-credit, writing-intensive courses: Introduction to College Writing, taken in the first year, taught by instructors in the University Writing Program, and junior-year writing in the discipline taught by a discipline-specific instructor working in collaboration with a writing specialist. From 1996, members of the UMass Chemistry program's junior-year writing class (essentially all chemistry majors) taught by myself (and Professor Holly Davis, a writing specialist at Smith College) were given an exercise in which they were asked to write an article for a non-science readership based on the contents of one original article in the primary peer-reviewed literature. Of the 16 times that this version of the course has been offered over the past 20 years, on 12 occasions the class was asked to explain the technical scientific content of "Arsenic in ground-water in 6 districts of west-Bengal, India - the biggest arsenic calamity in the world: 1. arsenic species in drinking-water and urine of the affected people" in language accessible to a non-scientific readership [ref 5]. In recent years, students were asked to write about the contents of either "Anthropogenic influences on groundwater arsenic concentrations in Bangladesh" [ref 6] or "Arsenic levels in rice grain and assessment of daily dietary intake of arsenic from rice in arsenic contaminated regions of Bangladesh—implications to groundwater irrigation" [ref 7]. Although the classes contained some students who had been involved in the general chemistry arsenic-related research projects that started in 2004, I estimate that a further 300 chemistry students have learned about the ground-water contamination in SE Asia, and of the importance of chemical analysis in supporting research directed towards an understanding the associated geochemistry and the impact on the local populations.

Instructional materials developed for the class formed the basis for a textbook in the Pearson Longman "Short Guide to Writing" series [ref 8]. Arsenic-in-the-environment topics are featured, though not to the exclusion of other topics, in the book when examples of particular types of writing are needed. As nearly 7,200 copies of the book have been sold (as of March 2016), it might be argued that the numbers of students aware of these topics is more than just the numbers of students taking the classes on the UMass Amherst campus.

CHEM 101 A General Education Course

In fall 2013, I offered a version of CHEM 101 (a 4-credit, physical sciences gen. ed. For non-science majors) with the provocative title "How Much Arsenic Do We Eat?" The course contained material not only to enable students to answer this question, but also to allow them to understand the possible health consequences of the chronic ingestion of small amounts of arsenic compounds (some of which are human carcinogens). Rice, therefore, featured prominently among the foodstuffs that were discussed. I have taught the course in the face-to-face mode on campus each spring semester since then to a total of about 600 students, I have also offered an online version of the course (also 4 credits) 12 times since the summer of 2013. The numbers are much smaller, typically 12 – 15 students per course for a total of about 170.

Faculty First-Year Seminar

For three fall semesters starting in 2009, I offered a 1-credit faculty first-year seminar (FFYS) entitled "Arsenic Around the World" in which I took a broad brush to the canvas of arsenic-related topics. After a sabbatical

break in 2012, I offered the seminar for a further three fall semesters, this time as "How Much Arsenic Do We Eat?" Each class contained about 15 students, for a total of about 90 students.

Public Engagement and Outreach.

I first used the title "How Much Arsenic Do We Eat?" in December 2011 for a public lecture demonstration sponsored by the American Chemical Society. This was my first attempt at getting members of the public involved as "citizen scientists" in the arsenic-in-rice project. At the time, the method we had developed (for the ITEST program) was able to detect inorganic arsenic in rice if it was present at a concentration of greater than, say, 200 parts per billion (ppb), and so (as much of the of rice in people's kitchens has concentrations below this value), many of the 20 or so participants failed to detect any arsenic. Refining this method has been an on-going research topic in my group, and has challenged a number of undergraduate students. The boundary conditions of only using reagents and equipment that one would encounter in the average kitchen make this a difficult method to develop. I have talked to general audiences about the arsenic in rice situation several times since then (at the Hitchcock Center, to students and parents at the Science Quest events at UMass, and to Girl Scouts at the Geek is Glam event at WPI). I was selected (along with this topic) to be a member of the first cohort of UMass Public Engagement Fellows, and during the tenure of my fellowship I wrote an article for a general readership that was published by The Conversation [ref 9]. According to the statistics available at the website, this article has been read almost 50,000 times.

Since fall of 2014, I have been helping Chemists Without Borders (CWB) with two of their arsenic-in-Bangladesh projects. The most recent of these, the development of a method for inorganic arsenic in rice that can be implemented in a basic lab by interns at the Asian University for Women in Chittagong, has become the focus of much attention. The University featured the work in a recent press release and associated video [ref 10], and my CWB colleagues have convinced me of the urgency of the work and so several undergraduates will be involved in the fall of 2016. Some of the restrictions of our kitchen method can be relaxed, and so the task would appear to be a little less daunting. CWB projects were described in a symposium at the American Chemical Society (ACS) conference in Philadelphia in August, which was featured in an issue of Chemical and Engineering News, the weekly magazine of the ACS that goes to all 157,000 members. In addition, the SCIX annual conference, organized by the Federation of Analytical Chemistry and Spectroscopy Societies, has for the past several years organized a session on "analytical chemists easing world poverty and/or solving global health challenges." The Fall 2016 SCIX conference will be the second time I have spoken about our work with CWB.

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UMASS Biotechnology Initiatives: Training in the Classroom, the Laboratory, and Beyond

Biotechnology is a major industry in Massachusetts and offers excellent career opportunities. This and the following article showcase two programs designed to increase the number of students preparing to enter this field..

Kevin L. Griffith, Assistant Professor, Microbiology Department, UMASS
Director of Applied Molecular Biotechnology and Biotech Boot Camp

Research intensive universities including UMASS-Amherst devote significant resources and training to doctorate programs in the life sciences. Often, less emphasis is placed on training Master's level students, despite a critical need for these positions in the workforce. A similar trend exists at the high school level. As a nation, we continue to lag behind other developed countries in high school STEM education (U.S. Bureau of Labor Statistics, 2009). The Microbiology Department is doing its part to help close the gap in training by developing several biotechnology programs geared toward strengthening education at the high school, undergraduate, and graduate levels. Our programs extend beyond traditional classroom instruction to include state-of-the-art research initiatives, summer internships, mentoring programs, and assistance in job placement.

Applied Molecular Biotechnology Program (AMB). The AMB program is a one year, professional M.S. program that combines rigorous classroom instruction with hands-on, applied laboratory research specifically designed to train students for entry in the biotechnology and pharmaceutical industries. The AMB laboratory serves as the capstone of the program. Students learn basic skills in molecular biology and biochemistry and then apply that knowledge to independent research projects that stem from current research interests at UMass and the surrounding colleges. Past projects include "characterizing toxin anti-toxin systems in *Bacillus subtilis,*" "elucidating the role of integrins in cancer metastasis," "understanding viral infection in honey bees," and "membrane biogenesis and pathogenesis in *Mycobacterium tuberculosis,*" to name just a few.

Efforts to train students extend beyond the classroom and the laboratory to include a mentoring program. Students are paired with experts in industry and academia where they receive individualized career advice and assistance in preparing application materials for future employment. In addition to mentoring students, we have worked with partners in industry to develop a summer internship program. Since its inception three years ago, ~90% of AMB students have been successfully placed into paid internships. For many, these internships have led directly to job opportunities, while other students have used AMB as a stepping stone for continued graduate and professional studies. For more information about the AMB program, please visit our website at https://www.micro.umass.edu/graduate/applied-molecular-biotechnology-masters.

Summer programs for high school teachers and students. One reason the US lags behind other developed nations in high school STEM education is the lack of in-depth science offerings at the high school level. Of the four learning standards for Massachusetts High School Science and Technology/ Engineering (STE), little attention is given to molecular biology, biochemistry, or biotechnology (Mass.

Science and Technology/Engineering Curriculum Framework, 2006). In many cases, laboratory training is limited or even non-existent. In an attempt to spark interest in life sciences research and to provide students with invaluable laboratory experience, we developed a summer camp geared toward rising junior and senior high school students. In addition, we have partnered with MassBioEd to bring high school professional development workshops in molecular biology to western Massachusetts.

Biotech Boot Camp (BBC). BBC is offered through the Pre-College Summer Program at UMASS-Amherst (http://www.umass.edu/summer/precollege.html). BBC is a summer camp designed for high school students interested in gaining hands-on research experience in molecular biology and biochemical techniques. Goals of the program are to create awareness for biotechnology and its uses, introduce students to basic laboratory techniques, develop critical thinking skills, and to generate an interest in scientific research. An emphasis is placed on experimental design, conducting experiments, interpreting results, and discussing experimental outcomes. To further expand students' learning experience, field trips are taken to different core facilities at the UMASS Institute for Applied Life Sciences (https://www.umass.edu/ials/core-facilities) including the genomics facility, the microscopy suite, and the animal imaging facility. At the end of the program, students present their work at a poster session open to the general public. The Pre-College Summer Program is a residential program that also offers students SAT/ACT preparation, and assistance with college applications. In addition, a variety of extracurricular activities are scheduled for students including Frisbee competitions, karaoke, talent show, a spa night, pizza parties, movie night, and a trip to Six Flags NE.

This summer was our inaugural boot camp and it exceeded our greatest expectations. Enthusiasm for the program was overwhelming and we had to turn students away due to limited laboratory space. Students came from all over the country, as far away as Colorado and California. We even had one student travel from China. Co-instructors Jeff Kane and Kelley Strickland worked all summer to develop fun and exciting experiments with real world applications including forensics science, biofuels, genetically modified organisms, and epidemiology. Look to enroll in Biotech Boot Camp early next year as space is limited for summer 2017 (http://www.umass.edu/summer/precollege.html).

BioTeach and the Summer Institute. MassBioEd is a non-profit organization that specializes in high school teacher professional development training (https://www.massbioed.org/). We are pleased to partner with MassBioEd to bring BioTeach and the Summer Institute to the UMASS campus. The BioTeach and Summer Institute programs are a series of work-shops that provide hands-on training in modern molecular and biochemical techniques. An emphasis is placed on teaching molecular concepts, educational approaches to integrate hands-on laboratory experience into high school curricula, and low cost methodologies for incorporating molecular techniques into high school classrooms. Not only do these workshops satisfy state license renewal requirements for "professional developmental points" or PEPs, but we now offer graduate credit for the 5 day workshop held over the summer. For more information about the programs offered by MassBioEd, please check out their website at https://www.massbioed.org/.

BioTeach Moves West

By Megan Schulz and Amanda Hayden, MassBioEd

In the past three years, hundreds of teachers and students from the Pioneer region have participated in the BioTeach Program from the Massachusetts Biotechnology Education Foundation (MassBioEd). BioTeach provides a variety of programs that train high school teachers in lab-centered, inquiry-based instructional techniques and provide students with college and career experiential learning opportunities. The expansion of BioTeach into Western Massachusetts was made possible through funding from the Department of Higher Education and with the support of UMass Amherst's STEM Education Institute, Department of Biology and Department of Microbiology.

Teacher professional development workshops made possible through this partnership allow teachers to practice modern molecular biology techniques such as gel electrophoresis, polymerase chain reaction, protein purification and cloning using Gibson assembly. These workshops also refresh concepts like photosynthesis, respiration, and enzyme function through inquiry-based labs.

In addition to teacher workshops, BioTeach organizes the **Summer Institute** at UMass Amherst. This week-long, lab-intensive summer training program for teachers is held in the Applied Molecular Biotechnology laboratory at UMass Amherst and qualifies for graduate credit through the Microbiology Department. Attendees work closely with the BioTeach team to hone basic biotechnology and molecular biology skills and techniques. Designed to mentor and support teachers, the multi-day, residential nature of the program provides the resources teachers need to implement new and advanced activities into their classrooms.

While the BioTeach program impacts thousands of students through their teachers, it also provides direct programming for students. At Career Exploration Days, life sciences companies host students for facility tours and job shadow opportunities, offering a behind-the-scenes look at the biotech industry. Students explore life sciences offerings at Massachusetts colleges and universities through a program called Biotech Futures.

Through the BioTeach program, MassBioEd reaches thousands of students every year. The impact made by MassBioEd lays the groundwork for a longstanding, educational community that is well positioned to inspire generations of students to consider a life sciences college and career path. Learn about the BioTeach program activities for the upcoming academic year through the MassBioEd website:

https://www.massbioed.org/educators/bioteach.

Patterns Summer Workshop

June 28 - June 29, 2016

Buckling, wrinkling, and blistering are all patterns in nature. UMass physics professors Benjamin Davidovitch and Narayanan Menon, along with Amherst Regional Middle School science teacher Jennifer Welborn, and Principal Wayne Kermenski of Hawlemont Regional School led nine teachers in a two-day course called Patterns in Nature hosted by the STEM Ed Institute. They explored the process of pattern recognition, analysis, and prediction through a variety of activities which align with the Massachusetts Frameworks.

MORT STERNHEIM WINS MAJOR AWARD

Morton M. Sternheim, Professor Emeritus of Physics, has received the **National Science Teachers Association (NSTA) Award for Distinguished Service to Science Education.**

Sternheim is currently the Director of the UMass STEM Education Institute and of the Pioneer Valley STEM Pipeline Network. He will be honored during a banquet at the 2017 NSTA national meeting in Los Angeles. These awards honor NSTA members who, through active leadership and scholarly endeavor over a significant period of time, have made extraordinary contributions to the advancement of education in the sciences and science teaching.

- Among the types of outstanding service that are considered by the committee are
- unique or extraordinary accomplishments in science teaching;
- active leadership in science or science education at the local, state, and national level;
- noteworthy scholarly contributions to science education at any level;
- focus of public attention on the need for improvement and better support of science education;
- direct and substantial contributions to the improvement of science education at any level;
- contributions over a significant period of time; and
- overall excellence of contributions.

"I have really enjoyed working with so many dedicated and talented teachers," Sternheim noted. He also praised his colleagues from UMass and area schools who made the programs so successful.

Praise for Mort Sternheim

Holly Hargraves

Dr. Morton Sternheim is a well-known and unique STEM educator at the University of Massachusetts Amherst whose career spans almost seven decades. He taught physics at the college level for about four of those decades, "retiring" in 1997; then becoming the Director of the STEM Education Institute. With a knack for writing and receiving competitive national and state grants, Mort offered comprehensive and varied programs for thousands of teachers. Combining the knowledge of the University's best scientists, and assisted by actual K-12 teachers, Mort's summer classes, Saturday Seminars, and STEM Tuesday talks all include a modeling of best practices: relevant lectures followed by hands-on labs, rich teacher discussions, and a constant infusion of methodology for teachers. Summative and formative evaluations consistently earned these programs high praise.

At eighty three, he works every day! He writes grants, updates multiple STEM websites, attends meetings with other higher education STEM professionals, and sends STEM announcements to thousands of teachers in the United States. Mort has written textbooks on physics; but his greatest strength is his ability to select and collaborate with other STEM professionals all with the goal of increasing interest in STEM fields. He will never stop being a STEM educator, and laughs off attempts to get him to really retire. His resume and narrative detail his dedication to STEM education and truly describe his *distinguished* career.

Cosmos: From the Origin of the Universe to the Evolution of Life and Intelligence

*Creating General Education science courses for non-science majors is a great challenge. UMass Professors **James Walker** (Biology) and **Steve Schneider** (Astronomy) offer a unique course that successfully engages students while giving them an understanding of evolution in the broadest sense. We asked Walker to tell us about Cosmos.*

I started the Cosmos course back in the Fall of 2002, so this will be its sixteenth year. Lynn Margulis came back from a National Academy of Sciences committee meeting in which it was suggested that a broad course such as this be taught and I thought it was a good idea and decided to develop such a course. Since then this type of course has become much more widespread through what is known as the "Big History" movement, in which an even broader course is given that includes the rise of civilization. My Cosmos course started out back in 2002 as a biology honors course with 8 faculty members from 6 departments (physics, astronomy, geosciences, microbiology, biology, and anthropology). In the Fall of 2008 it was given as a biology Gen Ed course and we had 200 students taking it. Initially this version of the course had 14 faculty members from 10 different departments representing 4 different colleges but soon Steve Schneider from Astronomy and I gave most of the lectures and I decided to go back to having it as an honors course, and since then Steve and I had done all the lectures. Steve covers the astronomy and physics topics: space, time, and the theory of relativity, matter, energy, and quantum mechanics, cosmology, galaxies, stars, and the elements, the solar system, and exoplanets. I cover the geologic time scale, plate tectonics and the evolution of the Earth, the origin of life, microbial life, the process of biological evolution, plants, animals, and human evolution, and the last week of the course Steve and I jointly discuss the Drake Equation and our views on how common intelligent life in the universe may be.

Here are some examples of Past Cosmos Course student comments:

"What a great course. This is the most interesting and exciting class I have ever taken. I plan to sit in on some lectures in the coming semesters."

"Best course ever— I wish it was two semesters."

"The idea for the course is fabulous. Thanks. This was enjoyable and educational."

"Subject material really interesting. Every UMass non-science major student should be required to take this course before graduating."

Course Description:

Astronomy 170H- Cosmos: From the Origin of the Universe to the Evolution of Life and Intelligence. 4 credits, Gen Ed (BS); Prerequisites: none. For Commonwealth Honors College students, freshmen and above (otherwise by permission of the course coordinator). Three lectures and one 2-hour discussion section each week. A course in astrobiology co-taught by an astronomer and an evolutionary biologist. Course covers the grandest panorama of all – beginning with the origin of the universe and ending with the rise of humanity. Emphasis is on the greatest questions posed by the human mind. Major topics include the ultimate nature of nature: space-time and matter-energy, origin and ultimate fate of the universe, evolution of galaxies, stars and the elements, origin of the solar system and the Earth, origin of life, the microbial world, plant and animal evolution, the process of biological evolution, primates and the origin and evolution of humans, and life and intelligence in the universe. Discussions cover some of the most interesting topics in the natural sciences today including evolution and the creationism-intelligent design debate; the theory of relativity and the nature of space and time; quantum theory and the ultimate nature of matter and energy; cosmology and dark matter/dark energy and the ultimate fate of the universe; the life of galaxies and stars and the formation of the elements; the solar system and the nature and diversity of meteorites; the Earth and plate tectonics; the nature and origin of life, the earliest evidence of life on Earth and the microbial world; Darwin and the process of biological evolution; evolution of plants; evolution of animals; human evolution; and the search for extraterrestrial life and intelligence. Specially created for students in the Commonwealth Honors College, this course provides the prerequisite scientific background that all well-educated persons of the 21st century should possess.

HUMOR and CLIMATE CHANGE

By Alexandra Pigeon, UMass Journalism Student

Students, professors and community members did the unthinkable on Tuesday afternoon at a STEM talk in Hasbrouck at UMass Amherst-- laugh at climate change.

Brian Adams, a professor emeritus of environmental science at Greenfield Community College, displayed his unconventional approach to teaching and writing about global warming using humor in front of about 30 people during this event put on by the Science, Technology, Engineering and Mathematics Education Institute.

Adams recognizes that the subject is overwhelmingly devastating and alarming, which caused him to reevaluate his methods of teaching it. He feared that simply laying down the facts would drive his students into a deep depression, causing them to "weep into their cereal," or worse, to bury their heads in the sand and ignore the issue altogether.

While Adams could not reiterate enough that "there is absolutely nothing funny about climate change," mentioning ocean acidification, world-wide famine and the mass-extinction of our fellow Earth-inhabiting species as a few of the disastrous consequences, he made the claim that we should laugh at the matter to stay sane.

The first part of his presentation consisted of a series of "memes" that he unapologetically stole from the internet, meant to display the ridiculousness of being a climate-denier, or one who believes that global warming is not real.

Adams, pointing out that about 95 percent of the world's scientists accept and have substantial evidence that climate change is, in fact, happening, used a quote from John Oliver, a political commentator and television host, to criticize all the attention given to debating this issue.

"One in four Americans is skeptical of climate change. Who gives a shit?" said Oliver. You don't need people's opinions on a fact." To constantly debate the issue is to suggest that there is equal weight to both sides of the argument, which is not the case, said Adams.

To those who still do not acknowledge the facts, Adams uses a poster from the Occupy movement to reason with them, pleading that they think logically about what makes more sense: environmental groups and activists everywhere using their limited funds to conspire with the majority of the world's scientists to create a hoax that could destroy the global economy, or big oil companies using their outrageous profit to bribe anyone they can to protect their future profit.

Making the necessary changes to stop and reverse the effects of global warming would not only be devastating to the profit of the oil companies, but for the average citizens would drastically change life as we

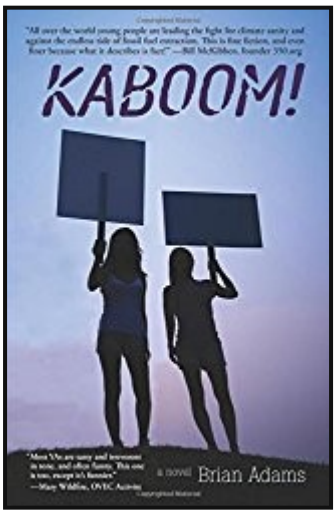
know it, he said.

“We are all addicts. We have a profound addiction to fossil fuels,” Adams said, admitting that he drove his 2001 Prius held together only by bumper stickers to the talk rather than choosing a “green” alternative form of transportation like a bus.

However for the most part, he makes a significant effort to live environmentally-friendly, he said.

He once made a comment to a stranger in a parking lot who left their car idling, secretly fighting the urge to slash his tires, he said. This behavior revealed a resemblance between him and Casey, the protagonist of his book “Love in the Time of Climate Change (2014).”

This novel is one of the few that represent a new genre of fiction referred to as “Cli-Sci Rom-Com (Climate -Science Romantic-Comedy),” which Adams himself pioneered. His stories use humor and romance to address the daunting topic of climate change and its catastrophic effects on the world.



In an act of “shameless self-promotion,” Adams read an excerpt from his novel in which Casey, a community college professor with “Obsessive Climate Disorder,” ruins a romantic encounter because of his inability to focus on anything other than the energy-wasting going on around him.

There is a risk in writing humor because people might not think you’re funny, or may even take offense, Adams said. “But I honestly believe it’s a way to reach people who would never read nonfiction about climate change.”

His second novel, “Kaboom” (2016), tells the tale of two teenage girls who become activists when their favorite mountain is threatened by a method of coal extraction that uses dynamite to blow mountaintops off.

The small classroom where the talk took place provided an intimate environment that allowed for discussion among Adams and his listeners.

Audience member Sue Bridge, founder of the local WildSide Gardens, commented on the strange phenomenon that people are not coming together to fix the mess we have gotten ourselves into. She recalls growing up during World War II when everybody rationed, grew their own gardens and lived responsibly in a transformative way, wondering why we aren’t doing so now.

“I think he was right how people get scared away because it’s such a heavy subject, that we all could die someday because of this,” journalism student Caroline McCann said of Adams.

Biology Professor Jeff Podos, also in the audience, brought some positivity to the table saying that in the past 10 years he has seen significantly more awareness on the issue and strides taken to make a difference, especially at UMass Amherst. The school has proven its position as a leader in sustainability across the nation by divesting from investments in fossil fuel companies and receiving numerous awards for being a “top green college campus,” Podos said.

“I’m optimistic that all of us can rise to the challenge,” Adams said.

More Climate Science Fiction: Cold Blood, Hot Sea

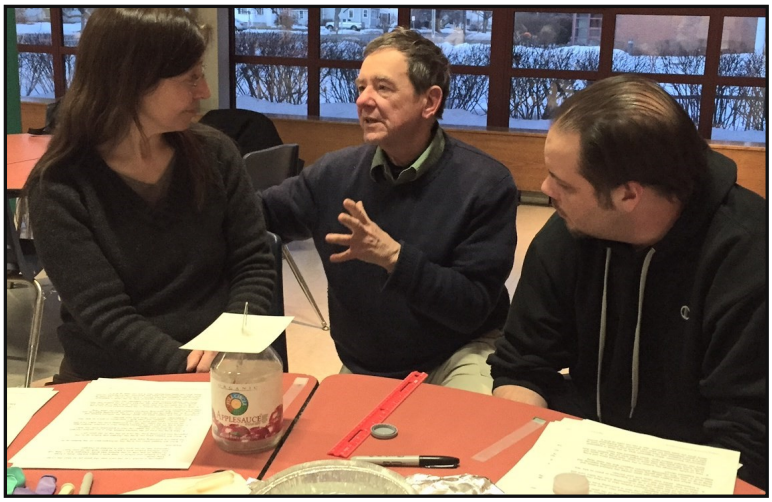
Charlene D'Avanzo is Professor Emerita of Ecology at Hampshire College. Her first novel, *Cold Blood, Hot Sea,* appeared this June. Like Adams, she uses Cli-Sci fiction to make climate change information accessible, but with an engaging murder mystery rather than humor. The book is the first in a projected Maria Tusconi mystery series. Tusconi shares D'Avanzo's Italian heritage and expertise in marine biology. When a falling buoy claims the life of a colleague aboard a research ship, Tusconi suspects it was not an accident. Neither the police nor the oceanographic institute makes a serious attempt to find out what happened, so she undertakes an investigation. In the meantime she is working with fishermen who are impacted by warming ocean temperatures and the negative effects it produces on their catches. The plot features aggressive climate change deniers, a fraudulent biofuel development scheme possibly supported by a big oil company, and two attempted murders of Tusconi. Of course she survives so that she can appear in the second mystery promised for next year.

STEM EDUCATION INSTITUTE

The Science, Technology, Engineering, and Mathematics Education Institute was established in 1995 to encourage K12 teachers to take science, technology, engineering and mathematics courses at UMass, and also to play a major role in meeting the University's goals in academic outreach, teaching and learning, research, diversity, and multiculturalism.

Science & Engineering Saturday Seminars

STEM ED



Designed for science, math, technology teachers; new teachers are especially welcome

- **Five Saturdays each term; 8:30-1 at UMass Amherst, Lederle Grad Towers 1033 (except as noted)**
- **Educational materials, refreshments, parking, PDP's included**
- **Advance registration is required; capacity is limited**
- **Register for as many sessions as you wish**
- **Cost: Early bird (up to Dec. 1) $30 for one seminar, $120 for all 5; later $35 for one, $140 for all 5; 4 PDP's per half day session; option for 3 grad credits at reduced cost with extra work**

Graduate credit option: There is a charge of $300 for 3 graduate credits plus a $45 registration fee; register for Nat Sci 697A (Cont & Prof. Ed) or 697 F (University). This is in addition to the $120 or $140 STEM Education Institute fee. Teachers may obtain credit for the seminar as many terms as they wish, but only 3 credits may be applied to UMass Amherst degrees. **Registration online for graduate credit is now done only online. See http://www.umassulearn.net/registration-info**; it is no longer done by completing a paper form. A lesson plan and a book report will be required for those enrolled for graduate credit.

Questions: Mort Sternheim, mmsternheim@gmail,com, 413-545-1908, www.umassk12.net/sess

Online seminar registration and payment: www.umassk12.net/sess/spring2017.html. Required for everyone whether or not they are registering for graduate credit.

Science & Engineering Saturday Seminars

Spring, 2017

February 4. Environmental Implications of Nanotechnology. Boris Lau, Environmental Engineering. Nanotechnology can be a double-edged sword. The same unique properties that enable the beneficial use of engineered nanoparticles (NPs) in water treatment and other novel applications also make their unintentional interactions difficult to anticipate. NPs are not only found in our latest gadgets, but are ubiquitous in the environment. Natural NPs influence important environment processes such as soil genesis and biogeochemical cycling of elements. The behavior of natural and engineered NPs, many of which serve as an avenue for rapid and long-range transport of contaminants in the environment, is an important topic for the safety of drinking water.

February 11. Patterns in Nature. Benjamin Davidovitch, Physics; Jennifer Welborn, Amherst Regional Middle School; Wayne Kermenski, Hawlemont Regional School. Patterns allow scientists the opportunity to view and study principles of the universe. If one knows the basic principles of the universe, one can explain why a pattern occurs. In this Saturday workshop, participants will observe patterns in nature and conduct experiments in order to explain these patterns.

March 4. Discovering the secrets of biology as told by a fruit fly. Sonia Hall, University of Massachusetts Medical School. Fruit flies have been revealing the mechanisms that regulate the development and health of organisms for over 100 years! We will explore tools from the model organism community that can be utilized to teach foundational biological concepts such as transcription, translation, and protein synthesis. These tools will then be used by participants to develop a project based educational module to teach course content related to cell division and cell biology as it relates to growth and development.

March 25. Superhero Robotics. Frank Sup, Mechanical and Industrial Engineering. The session will focus on exoskeleton technologies and is designed to give students a safe, hands-on learning experience that resonates with their STEM classwork. The program will offer teachers motivating scientific materials using a simple robotic elbow exoskeleton to use in their own classrooms. Please bring a laptop.

April 8. Building Green with Wood. Peggi Clouston, Environmental Conservation. Climate change can be tackled in two ways: by reducing carbon emissions and by removing carbon from the atmosphere. Wood is unique in that it is the only building material that can do both. In this seminar, we will look into recent innovations in wood technology, new uses of wood in large scale and high-rise construction, and learn the wide range of benefits of building with wood including environmental benefits. Participants will experience first-hand how wood performs as a structural material with class demonstrations, lab activities, and 'make-it and break-it' sessions. An additional bonus is that the **class will take place in the brand new UMass Design Building,** a state-of-the-art timber frame structure.

April 29. Weather makeup day if needed.

May 6. Recall for those enrolled for graduate credit. **Hasbrouck lab.**

For more information, email Holly Hargraves
STEM Program Manager holly@hollyhargraves.com

STEM ED

UMass STEM Ed Institute Presents: Fall 2016

STEM Tuesday TALKS

Most STEM seminars are held at 4PM on the first and third Tuesdays of each month during the academic year in Hasbrouck 138. Everyone is welcome; no reservations are needed, and there is no charge. Parking is available in the Campus Center Garage.

September 20th

Humor and Climate Change - (See review page 15-16)

Brian Adams
Author, Love in the Time of Climate Change and KABOOM
Professor Emeritus of Environmental Science at Greenfield Community College

There is nothing funny about climate change. Yet even in the midst of potential environmental chaos, humor can be an awesome tool to engage students and open up avenues for discussion about environmental issues. Brian Adams is the author *of Love in the Time of Climate Change* and *KABOOM!,* two romantic comedies about climate disruption and mountaintop removal, and a Professor Emeritus of Environmental Science at Greenfield Community College. He will lead a discussion of how to use humor as a way to promote awareness of the most humorless of topics.

October 4th

Physics 131 - Reflections on transition to Team Based Learning

Brokk Toggerson
Physics Department
University of Massachusetts, Amherst

The 2015 - 2016 school year represented a continuation of the effort to transition Physics 131 - Algebra-Based Introductory Physics I to a fully flipped model in the TBL space with integrated lab. This talk will reflect on the experience and discuss some implications for future reforms.

October 18th

State of STEM Student Success and Diversity at UMass

Charlana Y. Simmons
Director, Northeast Louis Stokes Alliance for Minority Participation in STEM
Director of Student Success & Diversity, College of Natural Sciences, UMass Amherst

The Director of Student Success and Diversity in the College of Natural Sciences will represent the state of diversity in STEM at UMass, providing details about the enrollment, persistence, and success of students from diverse backgrounds in STEM. The talk will also include information regarding best practices for supporting students in STEM and an outline of next steps of STEM diversity endeavors at UMass.

November 1st

STEM Mentoring

Becky Wai-Ling Packard
Professor of Psychology and Education
Director of the Weissman Center for Leadership at Mount Holyoke College

Becky Wai-Ling Packard is Professor of Psychology and Education, and Director of the Weissman Center for Leadership at Mount Holyoke College. Professor Becky Wai-Ling Packard will talk about her new book Successful STEM Mentoring for Underrepresented Students: A Research-Based Guide. If you are starting a new mentoring initiative, taking a second look at an existing one, or want to move beyond a program into a culture of mentoring in your department or organization, please do join us to learn more.

More about Professor Becky Packard:
http://www.mtholyoke.edu/~bpackard

November 15th

National Science Foundation's STEM Student Experiences Aboard Ships program

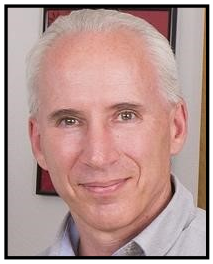
Mark Leckie, Professor
Chief Undergraduate Advisor for Geology & Earth Systems, UMass Amherst

Details unavailable at press time

December 6th

Global Challenge in Higher Education and Research

Joseph B. Berger, Ph.D.
Interim Senior Associate Dean
Director, Center for International Education
Department of Educational Policy, Research & Administration



The Worldwide Universities Network (WUN) Global Challenge in Higher Education and Research (GHEAR) addresses the sources, mechanisms, and social structures that give rise to today's higher education challenges, and works collaboratively across a network of 18 universities on 5 continents to propose reform policies for international research and education.

- Access - How do educational policies and practices promote equity of opportunity to succeed in university and beyond?
- Mobility - How does higher education respond to and facilitate greater mobility of people, learning, and knowledge?
- Investment - How can financial resources be more effective and efficient in promoting access, mobility, quality and relevance in higher education?